CORRESPONDENCE

Hackney Downs,
May 20th, 1909.

Dear Sir,—I do not wish to break the unwritten law which is to the effect that an author's answer to a discussion is final, but there are several points in Mr. Lanchester's answer to which I am compelled to reply.

In paragraph (1) Mr. Lanchester frankly states that my arithmetic is at fault. Let me correct him.

In the "Aëronautical Journal," October, 1908, p. 116, the diam. of the Wright propeller is given as 9′ 4″. Mr. Lanchester gives it as 8′ 6″. The propeller seemed to me to be about 9′ in diam. Let us take this diameter as being about the mean. The outside diam. of the Farman propeller is 7′ 6″, and the inside diam. to the blades is about 2′ 8″. The Wright machine is 24-H.P. and the Farman 50-H.P.

The area of a 9′ circle = 63.6 sq. ft.
,, ,, 7′ 6″ ,, = 44.2 ,,
,, ,, 2′ 8″ ,, = 5.6 ,,

There are two propellers on the Wright machine and only one on the Farman machine.

$$\frac{\text{Air engaged by propellers of Wright machine}}{\text{Air engaged by propeller of Farman machine}} = \frac{2 \times 63{\cdot}6}{44{\cdot}2 - 5{\cdot}6} = \frac{127{\cdot}2}{38{\cdot}6} = \frac{3{\cdot}3}{1}$$

$$\frac{\text{Air engaged } \textit{per H.P.} \text{ by Wright propellers}}{\text{Air engaged } \textit{per H.P.} \text{ by Farman propeller}} = \frac{3{\cdot}3 \times 50}{1 \times 24} = 6{\cdot}9 \text{ nearly.}$$

This agrees with my statement. It will be seen that Mr. Lanchester appears to have neglected the horse-power and the fact that the Voisin propeller has a central non-acting portion.

I am glad to see that in paragraph (2) Mr. Lanchester has acknowledged that if two propellers are placed axially or in tandem, the hind one should be of larger diam. This is a step in the right direction, namely, placing them *side by side*. For the most efficient working with this disposition the hind propeller would be of a complicated construction. The central portion would have to engage air that has been already accelerated, and would have to impress a further velocity upon it, whereas the outer portion would have to engage undisturbed air. Since all parts of the propeller would revolve at the same speed, the pitch of the inner portion would require to be of considerably greater pitch than that of the other portion. We should thus get an ungainly, impracticable stepped construction.

Mr. Lanchester's remarks in paragraph (7) are a complete verification of my statements. It is well known that the *kinematic dispersion* of a gas is much greater than that of a liquid, or, as I put it before, the loss due to exchange of momentum between two strata of air moving relatively is similar to the exchange of momentum that would result if people jumped from a train going at one speed into another going at another speed. It must be remembered that the velocity of the molecules of a gas is enormous. In the case of air it is somewhere about 2,000 ft. per sec. As a result of this high velocity the attraction of the molecules for one another is entirely overcome, with the result that any quantity of a gas—no matter how small—will expand to fill any space no matter how large. In the case of a liquid the velocity of the molecule is not sufficient *to overcome all influence of molecular attraction*, and thus, in water, we get the phenomena of *surface tension* and *cohesive force*, or, as Sir Hiram and I have put it, "Water wets a surface." The result of this is that, in the case of a ship moving through water, the cohesive force enables a certain quantity of water continually to drag on the side of the vessel. The water has no velocity when the ship first meets it, but due to this drag at the sides it acquires a considerable velocity by the time the vessel has passed, thus giving rise to losses known as skin friction. In the case of air, if the body is well shaped and polished, since there is no appreciable molecular attraction between the air and the body there is not the corresponding drag. The only skin friction which can occur, as previously pointed out, is that due to kinematic dispersion, and would result only if some air were carried along with the plane. We should thus expect to find that rough-shaped bodies, or the like, which trapped a certain amount of air, would have a larger resistance. This is so according to experiment. The losses due to kinematic dispersion for a gas, although greater than for water, are very small in comparison with those due to molecular drag in the case of water, and do not appear to justify Mr. Lanchester's high co-efficient of skin friction which on page 221, Part I., of his book is given, for *small velocities*, as = 0.02 or $\frac{1}{50}$ of the propelling force, when the plane is *normal*. When the plane is inclined it is true that a certain volume of air is continually carried along with the plane, and kinematic dispersion losses occur. These losses increase the head resistance, but cannot be considered as additional skin friction losses.

Maxim, the Wrights, Langley, Kress, Clerk-Maxwell, and others have all said either that the skin friction is exceedingly small, or that it may be safely neglected. In support of these statements it may also be mentioned that a certain very carefully-shaped wooden plane, when mounted at a particular angle,

gave a drift so small that it was not possible to measure it. (See Sir Hiram's book, page 57.)

With regard to Mr. Lanchester's remarks in paragraph (8) on Sir Hiram's propellers, it should be stated that Sir Hiram used, 16 years ago, propellers of 17′ 10″ diam., and would have used propellers of 24′ diam. if it had been possible. (See Sir Hiram's book, page 150.)

Mr. Lanchester's remarks about "the cloven hoof" are quite irrelevant since this is neither a theological nor a zoological discussion. My query as to the air rising up to meet the plane was certainly quite independent of Sir Hiram, and was first raised before I knew that he held the same view. I have known and worked with Sir Hiram for many years, and our views on aëronautical matters agree very well. I, therefore, naturally used in support of my arguments some statements which he has often published during the last 14 years. Since Sir Hiram did not know, in this case, that I intended to join in the discussion of Mr. Lanchester's able and valuable paper, it is a pity that aspersions have been cast upon him.

Yours very truly,

ALBERT P. THURSTON.

Foreign Aëronautical Publications

(In this list a selection of the more notable articles only is given.)

L'Aerophile

April 1st, 1909.—The Wings of Aëroplanes.—A Gyroscopic Pendulum.—The Equilibrium of Aëroplanes.—Fundamental Equations (Drzewiecki).—Notes on Dirigibles.

April 15th, 1909.—The Progress of American Aëroplanes.—"Breguet-Richet No. 2."—"Zeppelin V."

May 1st, 1909.—The Russian Aërodynamical Institute.—Some Aviation Questions (Soreau).—Guns and Dirigibles.—The Recent "Zeppelin" Trials.

May 15th, 1909.—The Hélicoptère Question.—Miscellaneous Aëroplanes (among others, the Weiss).—A Special Compass for Aëronauts.

June 1st, 1909.—Sailing Flight.—Miscellaneous Aëroplanes.—Dirigibles.

June 15th, 1909.—Aërodynamic Research Apparatus (Rateau).—Miscellaneous Aëroplanes.—"Zeppelin II."

Aeronautics (America)

April, 1909.—Soaring Flight (Chanute).—Aërial Experiment Association.—At Morris Park.

June, 1909.—Front and Rear Control of a Machine.—Propeller Mathematics.—Construction Data.

La Revue de l'Aviation

April, 1909.—Stability.—Aërial Screws (several articles).—An Aëronautical Level.—On the Velocity of Translation.

May, 1909.—Aërial Legislation.—The Secret of the Bird.—On the Velocity of Translation.—Trials of Aërial Screws.

June, 1909.—Gliding Flight (Chanute).—Aëronautical Workshops.

Societa Aeronautica Italiana

No. 4.—The Principles of the Conservation of Energy Applied to Aëronautical Work.—Miscellaneous Aëroplanes.—Dirigibles.—Aëronautical Motors.—Scientific Chronicle.

L'Aero-Mechanique

April 10th, 1909.—Considerations on Aërial Navigation.—The Graham-Bell Aëroplane.—The Thrust and Power of Aërial Screws.—Olympia Exhibition.

May 10th, 1909.—Gliding Flight (Chanute).—The Olympia Exhibition.—Notes.

June 10th, 1909.—Gliding Flight.—The International Wing Committee.—Beating Wings.—Notes.

Illustrierte Aeronautische Mitteilungen

April 7th, 1909.—Airship Sheds Design (very well illustrated).—Miscellaneous Notes.

April 21st, 1909.—Aëronautical Work on the East African Expedition.—German Flying Machines.—The "Itala."—Miscellaneous Notes (the Olympia Exhibition).

May 5th, 1909.—Aëronautical Work on the East African Expedition.—Sixth Conference of the International Commission for Aëronautics (Monaco).—Aëroplanes.—The Frankfort Exhibition.

May 19th, 1909.—Dirigibles and Esperanto.—English Notes.—Varieties.—The Frankfort Exhibition.

June 2nd, 1909.—The Theory of Flight; miscellaneous questions.—English Notes.—Varieties.—The Frankfort Exhibition.

Wiener Luftschiffer-Zeitung

April 1st, 1909.—Flights of the "Zeppelin" Balloon.

April 11th, 1909.—The "Zeppelin" Airship.—The Monaco Aërial Conference.—The Teneriffe Observatory.

May 1st, 1909.—The "Zeppelin" Airship. The Victoria-Nyanza Expedition.

May 15th, 1909.—The Aëronautical Commission.—The Frankfort Expedition.

June 1st, 1909.—The Aëronautical Commission.—About the Zeppelin Balloons.

June 15th, 1909.—Airship Societies.—Balloon Meteorology.—The "Zeppelin" Airship.